

**PROBLEM REPORTING MANAGEMENT SYSTEM PERFORMANCE SIMULATION**

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**SUMMARY**

This paper proposes the Problem Reporting Management System (PRMS) model as an effective discrete simulation tool that determines the risks involved during the development phase of a Trouble Tracking Reporting Data Base replacement system. The model considers the type of equipment and networks which will be used in the replacement system as well as varying user loads, size of the database, and expected operational availability. The paper discusses the dynamics, stability, and application of the PRMS and addresses suggested concepts to enhance the service performance and enrich them.

**INTRODUCTION**

The purpose of the PRMS simulation is to develop an understanding of potential system behavior, with the goal of using that understanding to make design decisions involving the system. The process of developing and running the simulation involves some combination of the following activities; preliminary analysis of proposed system design; model design and coding; verification; validation; experimental design; performing simulation runs to produce output data; and statistical analysis of output data to estimate parameters. Each of these activities contributes to an understanding of the system behavior.

The intent of this paper is to describe the performance model of the PRMS. Performance modeling is a technique that employs classical operations research and simulation to quantify process improvements and expected operations performance in the spirit of Total Quality

Management Continuous Improvement. As a TQM tool, performance modeling is a natural extension of the flow chart, the histogram, the cause and effect ("fish bone") diagram, and other statistical process control tools. Performance modeling allows managers to both visualize and quantify a process, and to project what effects changes will have on that process.

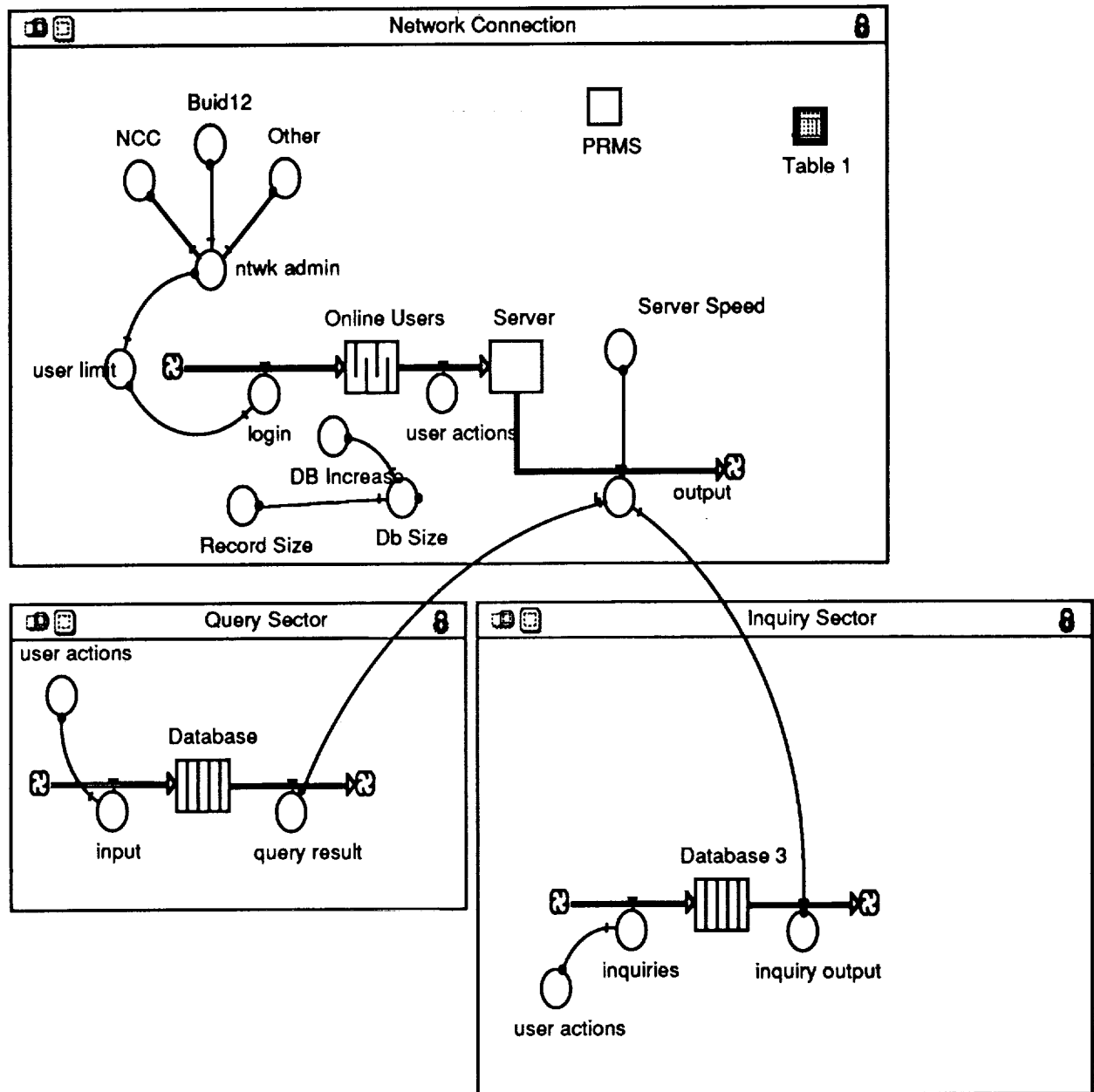
## **MODEL SPECIFICATIONS**

Use of NASAs Trouble Tracking Reporting Data Base (TTRDB) has increased significantly over the past few years. Reporting requirements provided by the TTRDB no longer satisfy the increased use of the system which currently serves the Space Network (SN). As a result, a replacement system, PRMS is being developed to replace the TTRDB. PRMS will support and provide enhanced reporting capabilities to the SN and the Ground Network (GN). Notwithstanding, the PRMS will accommodate reporting capabilities for the Second TDRSS Ground Terminal (STGT), The White Sands Ground Terminal Upgrade (WSGTU), the Gamma Ray Observatory Remote Terminal System (GRTS) and four TDRSS operations. Current reporting capabilities are not configured to handle report inputs from STGT and WSGTU site configurations or for more than three TDRSS operations. The PRMS will also contain the required provisions for maintaining problem reports on ground sites supporting the Network Control Center (NCC) scheduled missions (Elwell, 1993).

The design of the PRMS is portrayed as a single server unit servicing multiple users in multiple locations. The functions of the system are to provide:

- Direct on-line entry, by NCC operations personnel,
- User logon/access security,
- Multilevel access characterized by user access security,
- Verifiable Data entry,
- Graphical User Interface,

# PRMS Database and Network Connection



**FIGURE 1. PRMS SIMULATION STRUCTURE AND NETWORK CONNECTIONS**

- Capability of building queries, generating output reports, batch processing, sorting, indexing, consolidation of existing reports, slaving reports to a master report, electronic approval, graphical output, and auto-numbering,
- Editing, appending, and viewing of reports, and
- Network capabilities.

## **MODEL ORGANIZATION**

A software organization was developed for implementation of an animated simulation model based on the previous information and forms of animated even. It includes a simulation model, a static background, static elements, a dynamic foreground, dynamic actors, and the trace file.

Figure 1 represents the basic simulation structure and network connections.

The simulation contains some initial sets of logical processes. Ideally, these processes should be distributed accross the system so that response time delays are minimized. Thus, the simulation model becomes a surrogate for actually being able to experiment with the yet to be built PRMS. Since random samples from input probability distributions combined with current usage rates of the TTRDB are used to “drive” this simulations model, basic simulation output data or an estimated performance measure computed from them are also random.

Because of the random nature of the simulation input, the PRMS model produces a statistical estimate of the (true) performance measure, not the measure itself (Bartley, Fox, and Schrage, 1987) .In order to predict statistically precise estimates that are free of bias;

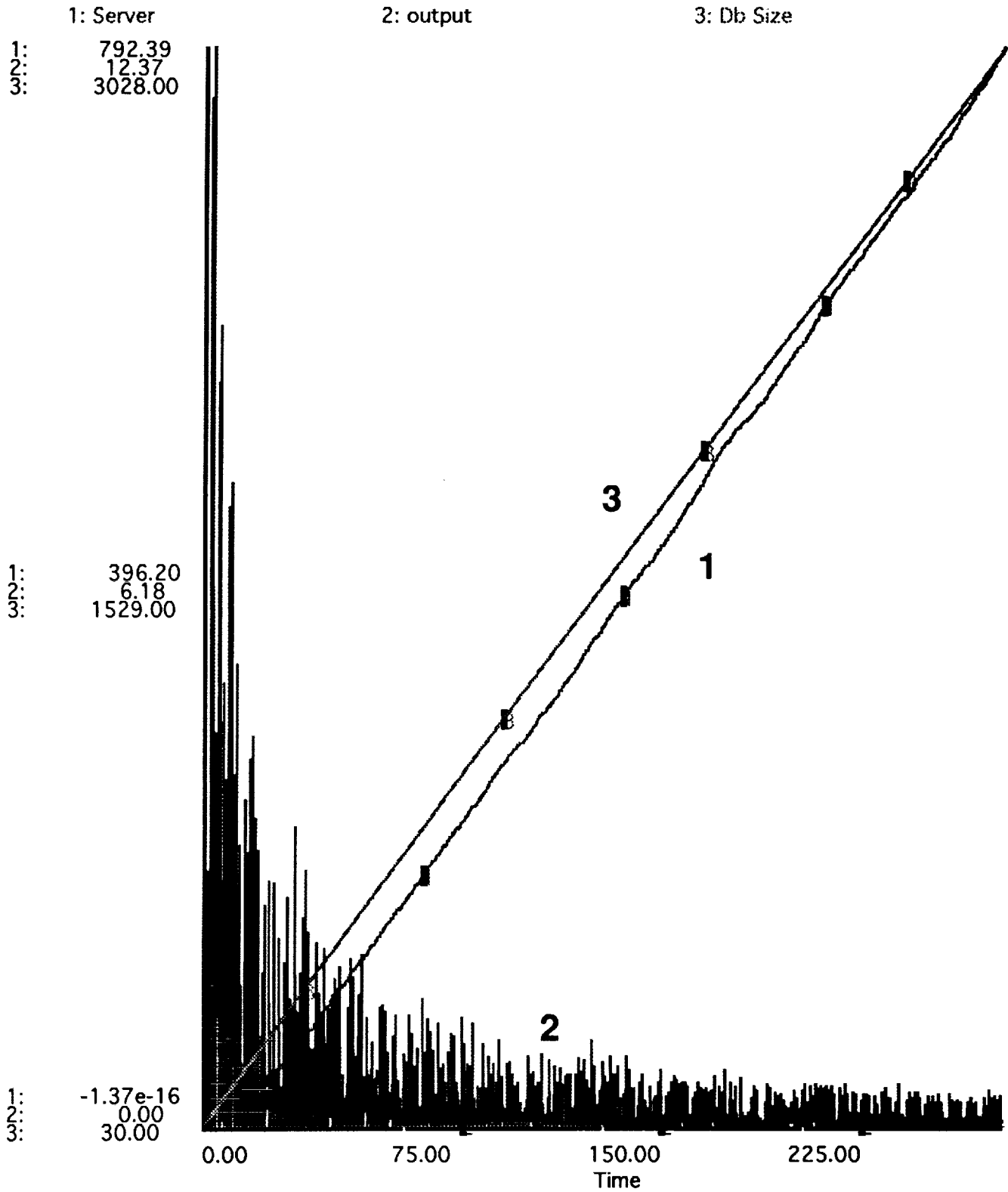
- The length of run was set at 1000 time units
- The number of independent simulation runs was set at 5, and
- No simulation warm-up period was needed.

The independent runs were made for each configuration of the system (386 based, 486 based, Macintosh based, etc.) , and the average of the estimated performance measures from the individual runs was used as the overall estimate of the performance measure. Independent runs mean using different random numbers for each run, starting each run in the same initial state, and resetting the model's statistical counters back to zero at the beginning of each run.

## **EXPERIMENTS**

The experimental study of the PRMS used three type of servers, a 486/33, a 486/66, and a Macintosh 840A. In all cases, a user action that arrives at the queue is sequentially served and is thereafter routed to either an input or an output function with a predetermined probability. The service time of a job at the server is generated from a negative exponential distribution in which all servers are assumed to have an identical mean service time related to their clock rates. The variants were the type of servers and the increase in user rates vs. data base size. An example graphic output is shown in Figure 2.

The simulation was run for each of the server types with varying user loads and data base usage rates. Steady state analytical models were used for comparison. (See Kleinrock, 1976 for a discussion on steady state analytical queuing models associated with computer and communications network performance issues.) The dynamic outputs, both numerical and visual, are being evaluated for performance vs. cost concerns.



**FIGURE 2. GRAPH OF OUTPUT AS A FUNCTION OF DATA BASE SIZE AND SERVER LOAD**

## **CONCLUSIONS**

The PRMS is still in the design phase. This model is being used to provide quantitative performance measures to substantiate a specific system platform to build on. The model will be expanded to include system maintenance and a more refined data base input mechanism as the design progresses. The simulations model has demonstrated that a number of optimizations can be performed transparently by a runtime model and that an accurate depiction of the PRMS can be made in its various states of design.

## **REFERENCES**

- Bratley, P., B. L. Fox, and L. E. Schrage. 1987. *A Guide to Simulation*, New York, New York: Springer-Verlag
- Elwell, D. 1993. *Problem Reporting Management System Operations Concept*, Greenbelt, Md:Goodard Space Flight Center
- Kleinrock, L. 1976. *Queing Systems*. Volume 2: Computer Applications. New York: Wiley.





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## SESSION 2: NETWORK OPERATIONS

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